



# Dual JK Negative Edge-Triggered Flip-Flop

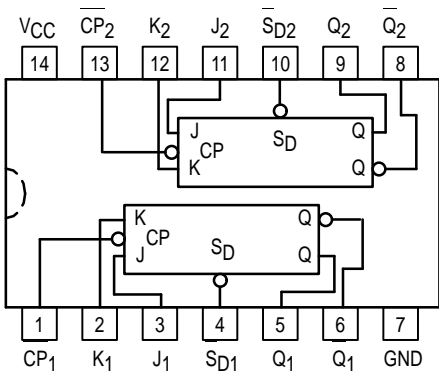
The MC74AC113/74ACT113 consists of two high-speed completely independent transition clocked JK flip-flops. The clocking operation is independent of rise and fall times of the clock waveform. The JK design allows operation as a D flip-flop (refer to MC74AC74/74ACT74 data sheet) by connecting the J and K inputs together.

Asynchronous Inputs:

- LOW input to  $S_D$  (Set) sets Q to HIGH level
- Set is independent of clock

- Outputs Source/Sink 24 mA
- 'ACT113 Has TTL Compatible Inputs

CONNECTION DIAGRAM



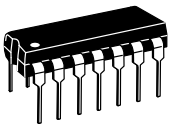
MODE SELECT — TRUTH TABLE

Operating Mode	Inputs			Outputs	
	$\overline{S_D}$	J	K	Q	$\overline{Q}$
Set	L	X	X	$\overline{H}$	L
Toggle	H	h	h	q	q
Load "0" (Reset)	H	l	h	L	H
Load "1" (Set)	H	h	l	H	$\overline{L}$
Hold	H	l	l	q	q

H, h = HIGH Voltage Level  
 L, l = LOW Voltage Level  
 X = Don't Care  
 l, h (q) = Lower case letters indicate the state of the referenced input (or output) one set-up time prior to the HIGH to LOW clock transition.

**MC74AC113**  
**MC74ACT113**

DUAL JK NEGATIVE  
 EDGE-TRIGGERED  
 FLIP-FLOP

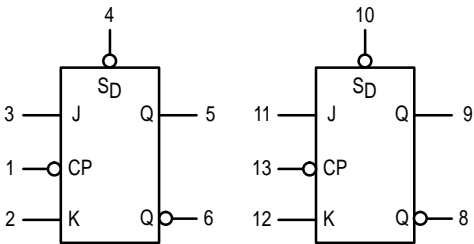


N SUFFIX  
 CASE 646-06  
 PLASTIC



D SUFFIX  
 CASE 751A-03  
 PLASTIC

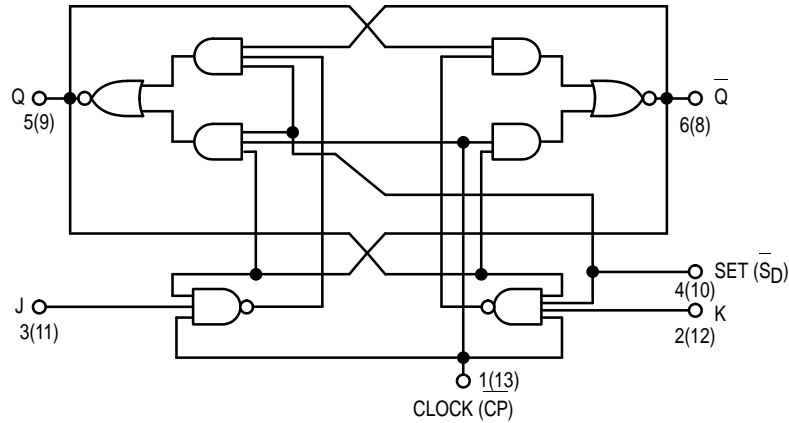
LOGIC SYMBOL



$V_{CC}$  = PIN 14  
 GND = PIN 7

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## LOGIC DIAGRAM (Each Flip-Flop)



### MAXIMUM RATINGS\*

Symbol	Parameter	Value	Unit
$V_{CC}$	DC Supply Voltage (Referenced to GND)	-0.5 to +7.0	V
$V_{in}$	DC Input Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$V_{out}$	DC Output Voltage (Referenced to GND)	-0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Input Current, per Pin	$\pm 20$	mA
$I_{out}$	DC Output Sink/Source Current, per Pin	$\pm 50$	mA
$I_{CC}$	DC $V_{CC}$ or GND Current per Output Pin	$\pm 50$	mA
$T_{stg}$	Storage Temperature	-65 to +150	°C

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

### RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Typ	Max	Unit
$V_{CC}$	Supply Voltage	'AC	2.0	5.0	V
		'ACT	4.5	5.0	
$V_{in}, V_{out}$	DC Input Voltage, Output Voltage (Ref. to GND)	0		$V_{CC}$	V
$t_r, t_f$	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	$V_{CC} @ 3.0 V$	150		ns/V
		$V_{CC} @ 4.5 V$	40		
		$V_{CC} @ 5.5 V$	25		
$t_r, t_f$	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	$V_{CC} @ 4.5 V$	10		ns/V
		$V_{CC} @ 5.5 V$	8.0		
$T_J$	Junction Temperature (PDIP)			140	°C
$T_A$	Operating Ambient Temperature Range	-40	25	85	°C
$I_{OH}$	Output Current — High			-24	mA
$I_{OL}$	Output Current — Low			24	mA

1.  $V_{in}$  from 30% to 70%  $V_{CC}$ ; see individual Data Sheets for devices that differ from the typical input rise and fall times.

2.  $V_{in}$  from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

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## DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		74AC	Unit	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = −40°C to +85°C		
			Typ	Guaranteed Limits			
V <sub>IH</sub>	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V
		4.5	2.25	3.15	3.15		
		5.5	2.75	3.85	3.85		
V <sub>IL</sub>	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V
		4.5	2.25	1.35	1.35		
		5.5	2.75	1.65	1.65		
V <sub>OH</sub>	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	V	I <sub>OUT</sub> = −50 μA
		4.5	4.49	4.4	4.4		
		5.5	5.49	5.4	5.4		
		3.0		2.56	2.46	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> −12 mA I <sub>OH</sub> −24 mA −24 mA
		4.5		3.86	3.76		
		5.5		4.86	4.76		
V <sub>OL</sub>	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	V	I <sub>OUT</sub> = 50 μA
		4.5	0.001	0.1	0.1		
		5.5	0.001	0.1	0.1		
		3.0		0.36	0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 12 mA I <sub>OL</sub> 24 mA 24 mA
		4.5		0.36	0.44		
		5.5		0.36	0.44		
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			75	mA	V <sub>OLD</sub> = 1.65 V Max
I <sub>OHD</sub>		5.5			−75	mA	V <sub>OHD</sub> = 3.85 V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	40	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\* All outputs loaded; thresholds on input associated with output under test.

† Maximum test duration 2.0 ms, one output loaded at a time.

Note: I<sub>IN</sub> and I<sub>CC</sub> @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V<sub>CC</sub>.

## AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			74AC		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = −40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max		
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	145 145			125 125		MHz	3-3
t <sub>PLH</sub>	Propagation Delay CP <sub>N</sub> to Q <sub>N</sub> or Q <sub>N</sub>	3.3 5.0	1.0 1.0		14.5 12.0	1.0 1.0	16.0 13.0	ns	3-6
t <sub>PHL</sub>	Propagation Delay CP <sub>N</sub> to Q <sub>N</sub> or Q <sub>N</sub>	3.3 5.0	1.0 1.0		14.5 12.5	1.0 1.0	15.5 13.0	ns	3-6
t <sub>PLH</sub>	Propagation Delay SD <sub>N</sub> to Q <sub>N</sub>	3.3 5.0	1.0 1.0		10.0 9.0	1.0 1.0	11.0 9.5	ns	3-6
t <sub>PHL</sub>	Propagation Delay SD <sub>N</sub> to Q <sub>N</sub>	3.3 5.0	1.0 1.0		13.0 11.0	1.0 1.0	14.0 11.5	ns	3-6

\* Voltage Range 3.3 V is 3.3 V ±0.3 V.

Voltage Range 5.0 V is 5.0 V ±0.5 V.

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## AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC		74AC	Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Typ	Guaranteed Minimum			
t <sub>s</sub>	Set-up Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	3.3 5.0		6.5 4.5	7.5 5.0	ns	3-9
t <sub>h</sub>	Hold Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	3.3 5.0		0 0	0 0	ns	3-9
t <sub>w</sub>	Pulse Width Clock	3.3 5.0		5.0 4.0	5.5 4.5	ns	3-6
t <sub>w</sub>	Pulse Width S <sub>D</sub> <sub>N</sub>	3.3 5.0		5.5 5.0	6.0 5.5	ns	3-6
t <sub>rec</sub>	Recovery Time S <sub>D</sub> <sub>N</sub> to CP	3.3 5.0		0 0	0 0	ns	3-9

\* Voltage Range 3.3 V is 3.3 V ±0.3 V.  
Voltage Range 5.0 V is 5.0 V ±0.5 V.

## DC CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	74ACT		74ACT	Unit	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = −40°C to +85°C		
			Typ	Guaranteed Limits			
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	V <sub>OUT</sub> = 0.1 V or V <sub>CC</sub> − 0.1 V
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	I <sub>OUT</sub> = −50 μA
		4.5 5.5		3.86 4.86	3.76 4.76	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> −24 mA I <sub>OH</sub> −24 mA
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	V	I <sub>OUT</sub> = 50 μA
		4.5 5.5		0.36 0.36	0.44 0.44	V	*V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> 24 mA I <sub>OL</sub> 24 mA
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
ΔI <sub>CCT</sub>	Additional Max. I <sub>CC</sub> /Input	5.5	0.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> − 2.1 V
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			75	mA	V <sub>OLD</sub> = 1.65 V Max
I <sub>OHD</sub>		5.5			−75	mA	V <sub>OHD</sub> = 3.85 V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	40	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\* All outputs loaded; thresholds on input associated with output under test.  
† Maximum test duration 2.0 ms, one output loaded at a time.

# MC74AC113 MC74ACT113

## AC CHARACTERISTICS (For Figures and Waveforms — See Section 3)

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT			74ACT		Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = −40°C to +85°C C <sub>L</sub> = 50 pF			
			Min	Typ	Max	Min	Max		
f <sub>max</sub>	Maximum Clock Frequency	5.0	145			125		MHz	3-3
t <sub>PLH</sub>	Propagation Delay CP <sub>N</sub> to Q <sub>N</sub> or Q <sub>N</sub>	5.0	1.0		14.0	1.0	15.5	ns	3-6
t <sub>PHL</sub>	Propagation Delay CP <sub>N</sub> to Q <sub>N</sub> or Q <sub>N</sub>	5.0	1.0		13.5	1.0	15.0	ns	3-6
t <sub>PLH</sub>	Propagation Delay SD <sub>N</sub> to Q <sub>N</sub>	5.0	1.0		11.5	1.0	12.5	ns	3-6
t <sub>PHL</sub>	Propagation Delay SD <sub>N</sub> to Q <sub>N</sub>	5.0	1.0		13.0	1.0	14.0	ns	3-6

\* Voltage Range 5.0 V is 5.0 V ±0.5 V.

## AC OPERATING REQUIREMENTS

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT		74ACT	Unit	Fig. No.
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = −40°C to +85°C C <sub>L</sub> = 50 pF		
			Typ	Guaranteed Minimum			
t <sub>s</sub>	Set-up Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	5.0		2.0	2.5	ns	3-9
t <sub>h</sub>	Hold Time, HIGH or LOW J <sub>N</sub> or K <sub>N</sub> to CP <sub>N</sub>	5.0		2.0	2.0	ns	3-9
t <sub>w</sub>	Pulse Width Clock	5.0		5.0	6.0	ns	3-6
t <sub>w</sub>	Pulse Width S <sub>D</sub> N	5.0		5.5	6.0	ns	3-6
t <sub>rec</sub>	Recovery Time S <sub>D</sub> N to CP	5.0		0	0	ns	3-9

\* Voltage Range 5.0 V is 5.0 V ±0.5 V.

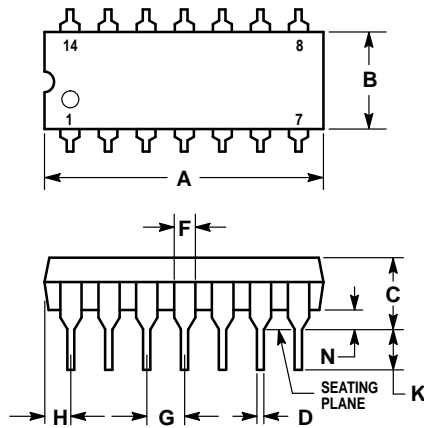
## CAPACITANCE

Symbol	Parameter	Value Typ	Unit	Test Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = 5.0 V
CPD	Power Dissipation Capacitance	35	pF	V <sub>CC</sub> = 5.0 V

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## OUTLINE DIMENSIONS

### N SUFFIX PLASTIC DIP PACKAGE CASE 646-06 ISSUE L

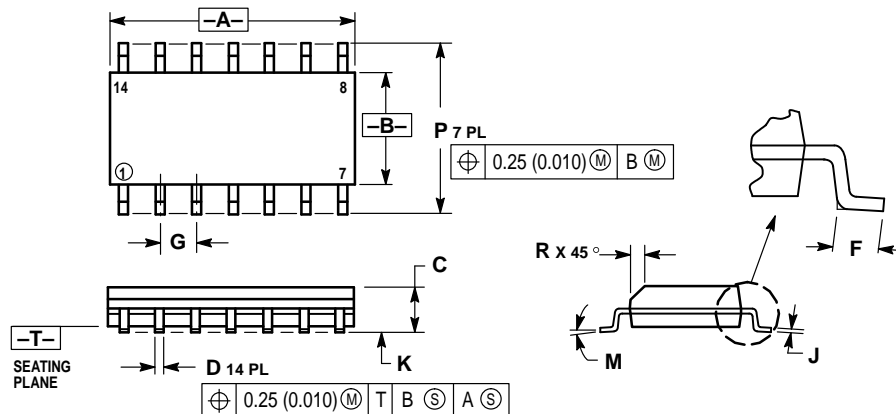


#### NOTES:

1. LEADS WITHIN 0.13 (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	19.56
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.300 BSC		7.62 BSC	
M	0°	10°	0°	10°
N	0.015	0.039	0.39	1.01


### D SUFFIX PLASTIC SOIC PACKAGE CASE 751A-03 ISSUE F



#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

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MC74AC113/D

